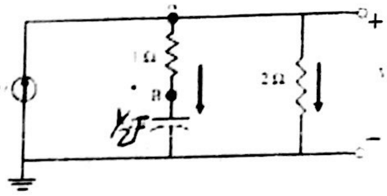
EE 362 Spring 2016
Homework # 2
Due: Saturday, March 26, 2016

Q1: a) Write the differential equation of *vo*(t)



b) Find the transfer function Vo(s)/I(s)

Figure (1)

Q2: For the mechanical system of Figure (2),

Find the transfer function X1/F

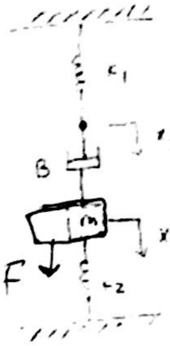


Figure (2)

Q3: Find the transfer function C(s)/R(s) by block diagram reduction

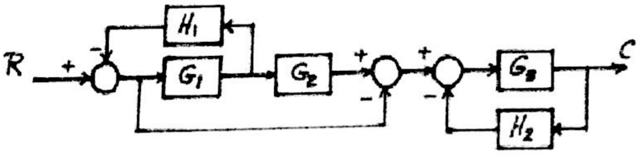
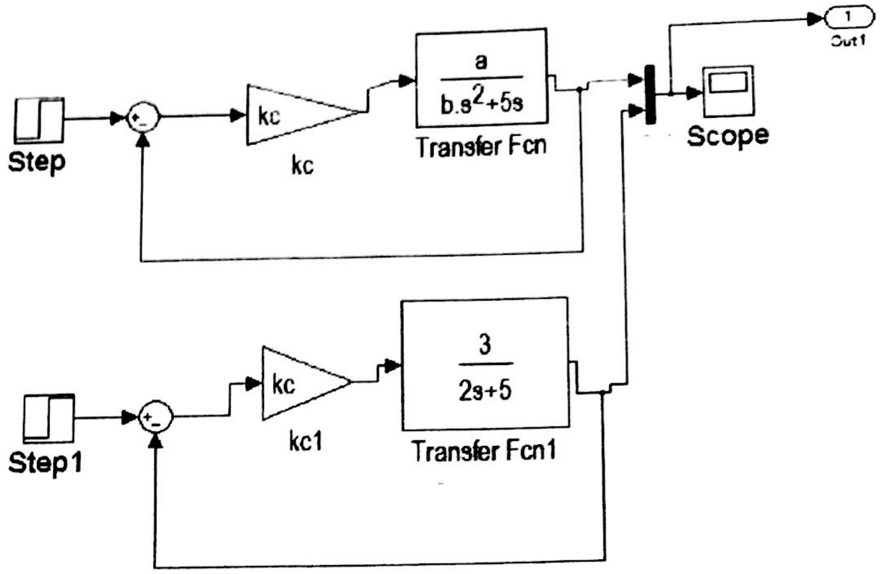


Figure (3)

Q:4 Convert Figure (3) to signal flow graph and find the transfer function C(s)/R(s) by Mason's rule

EE362 spring 2016
HW #3
Due : Tue. 29/03/2016



Q1: Find the sensitivity of the system with respect to a and b.

Choose different values for kc and show its effect on improving the sensitivity by plotting the output of both systems.

***Note:** show at least 3 plots for b and 3 plots for a with fixing the other parameter*

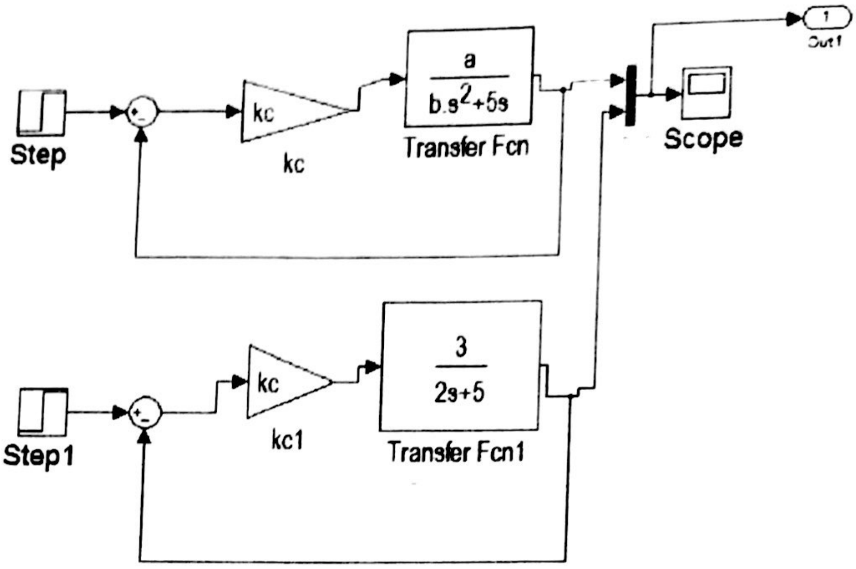
Use Simulink to show your results

Plotting:

In MatLab Command window, type:

```
>> subplot(3,2,1)
>> plot(tout,yout)
>> subplot(3,2,2)
>> plot(tout,yout)
```

EE362 spring 2016
HW #3
Due : Tue. 29/03/2016



Q1: Find the sensitivity of the system with respect to a and b.

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```
>> subplot(3,2,1)
>> plot(tout,yout)
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>> plot(tout,yout)
```
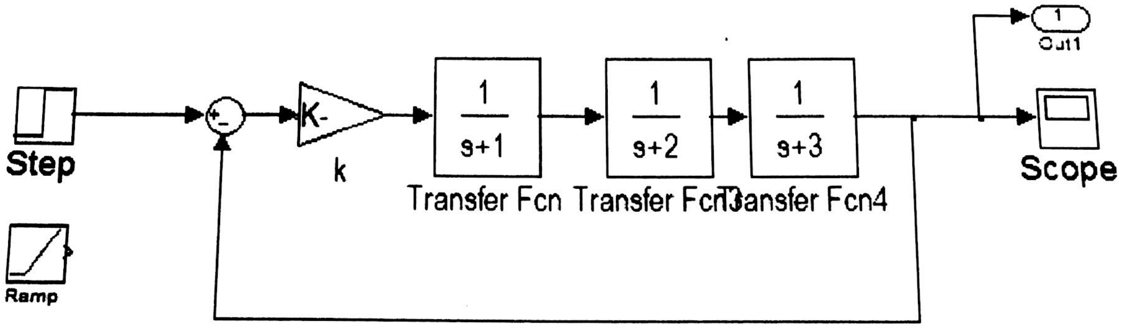

EE362 HW# 5 Spring 2016

28/4/2016

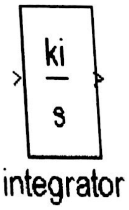
د. محمد بدران



In all of the following detrmine the steady-state error and discuss your results

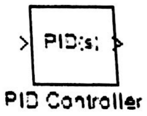
Q1: Choose two different values of "k" in the stable range and and show the step response

Q2: Replace the amplifier with integrator with different values of "ki" and check the step response



Q3: Repeat Q2 for remp input

Q4: Repeat Q2 for PI controller using the MatLab block Set D=0



Note: Use the commands: >>plot( ) , subplot, to show all of your results

MAR 428 Home work 1 due to Saturday 19-3-2016

Q1 (a) State the general objectives of control system.

(b) Find the overall transfer function for the following system using block diagram approach.

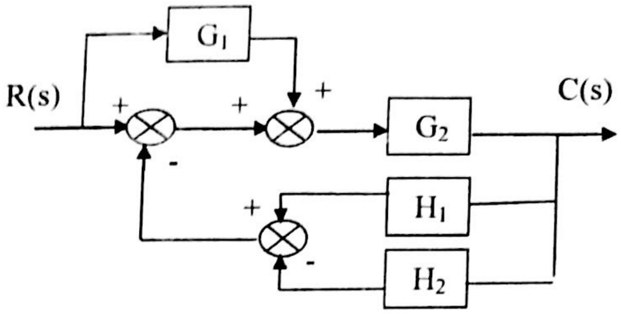


Fig a

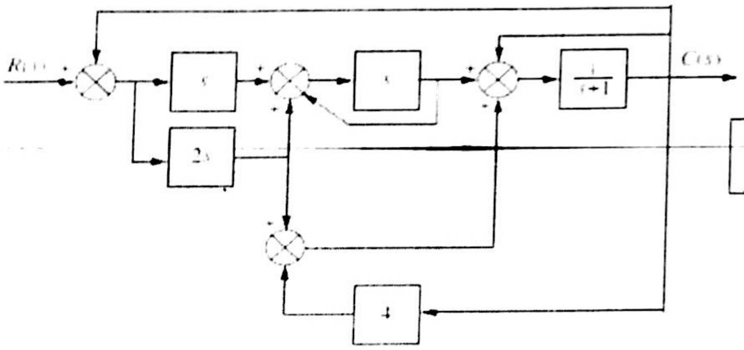


Fig b

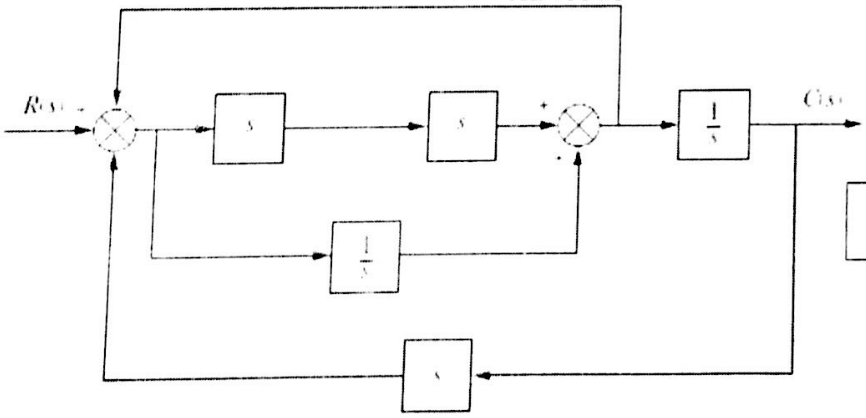


Fig c

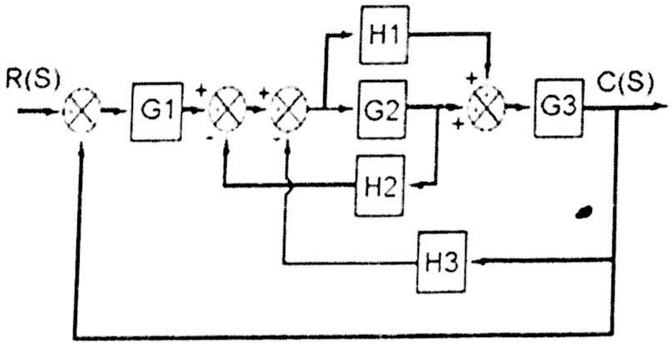


Fig d

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24/10/2013

د. أسامة ابو الريحه

د.ل 22,5

Homework #1

problem #1)

A laser printer uses a laser beam to print copy rapidly for a computer. The laser is positioned by a control input r(t), so that we have

$$Y(s) = \frac{4(s+50)}{s^2+30s+200}\, R(s)$$

The input r(t) represents the desired position of the laser beam.

(a) If r(t) is a unit step input, find the output y(t)?

(b) what is the final value of y(t)?

problem #2

A system is described by the following differential equation:

$$\frac{d^3y}{dt^3} + 3\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + y = \frac{d^3x}{dt^3} + 4\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 8$$

find the transfer function Y(s)/X(s)?

_ 6,3

$(s+19)$ $(s+3)(s+11)(s$

ity feedback system has the following forward transfer function: 25/12/2013

$$G(s) = \frac{10(s+20)(s+30)}{s(s+25)(s+35)}$$

find the steady state error for the following inputs

$\boxed{1}$ $15u(t)$ $\boxed{2}$ $15tu(t)$ $\boxed{3}$ $15t^2u(t)$

for $\boxed{1}$ $e_{step}(\infty) = \lim_{s\to 0} s\,\frac{R(s)}{G(s)+1} = \lim_{s\to 0} \frac{\cancel{s} * \frac{15}{\cancel{s}}}{G(s)+1} = \boxed{0}$

for $\boxed{2}$ $e_{ramp}(\infty) = \lim_{s\to 0} \frac{\cancel{s} * \frac{15}{s^{\cancel{2}}}}{G(s)} = \lim_{s\to 0} \frac{15}{\cancel{s} * \frac{10(s+20)(s+30)}{\cancel{s}(s+25)(s+35)}} = \boxed{2.187}$

for $\boxed{3}$ $e_{parabolic}(\infty) = \lim_{s\to 0} \frac{\cancel{s} * \frac{15}{\cancel{s^3}}}{G(s)} = \lim_{s\to 0} \frac{15}{s^2 * \frac{10(s+20)(s+30)}{s(s+25)(s+35)}} = \boxed{\infty}$

Q An input of $25t^3u(t)$ is applied to the input of a type 3 unity feedback system as shown where :-

$$G(s) = \frac{210(s+4)(s+6)(s+11)(s+13)}{s^3(s+7)(s+14)(s+19)}$$

1

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$$E(s)=\frac{R(s)}{1+G(s)}=\frac{150/s^4}{1+\frac{210(s+4)(s+6)(s+11)(s+13)}{s^3(s+7)(s+14)(s+19)}}$$

transfer fun

$$e(\infty)=\lim_{s\to 0} sE(s)=\frac{150}{\frac{210(4)(6)(11)(13)}{(7)(14)(19)}}=0.387$$

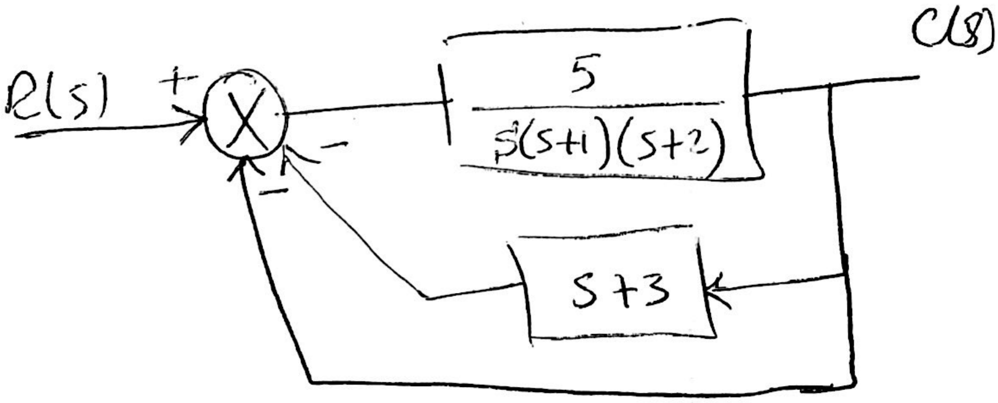
Q For the system shown below

ⓐ find Kp, Kv, and Ka

ⓑ find the steady state error for an input of 50u

50tu(t) and $50t^2u(t)$

ⓒ state the system type



$$G_e(s)=\frac{\frac{5}{s(s+1)(s+2)}}{1+\frac{5(s+3)}{s(s+1)(s+2)}}=\frac{5}{s(s+1)(s+2)+5(s+3)}=\frac{5}{s^3+3s^2+7s+1}$$

$$p = \lim_{s \to 0} G_e(s) = \frac{\frac{1}{5}}{\frac{15}{3}} = \frac{1}{3}$$

$$K_V = \lim_{s \to 0} s G_e(s) = 0$$

$$K_a = \lim_{s \to 0} s^2 G_e(s) = 0$$

ⓑ for $50u(t) \Longrightarrow e(\infty) = \frac{50}{1+K_p} = 37.5$

for $50t\,u(t) \Longrightarrow e(\infty) = \infty$

for $50t^2u(t) \Longrightarrow e(\infty) = \infty$

ⓒ Type 0

Q Given the unity feedback system shown below

$$G(s) = \frac{100500(s+5)(s+14)(s+23)}{s(s+27)(s+\alpha)(s+33)}$$

find the value of α to yield $K_V = 25000$

$$K_V = \lim_{s \to 0} s G(s) = \frac{100500(5)(14)(23)}{(27)(\alpha)(33)} = 25000$$

$$\boxed{\alpha = 7.26}$$

Q For the unity feedback system, where

$$G(s) = \frac{K(s+13)(s+19)}{s(s+6)(s+9)(s+22)}$$

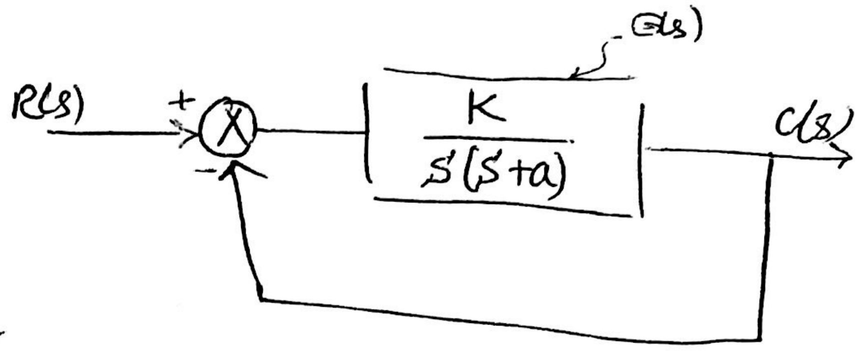
Find the Value of K to yield a steady state error of 0.4 for a ramp input of 27t u(t)

$$e_{ss} = \frac{27}{K_v} = 0.4$$

$$K_v = \lim_{s \to 0} sG(s) = \frac{K(13)(19)}{(6)(9)(22)}$$

$$0.4 = \frac{27}{\frac{K(13)(19)}{(6)(9)(22)}} \Longrightarrow \boxed{K = 325}$$

(6) system shown below find the sensitivity of steady state error to changes in parameter "k" and parameter "a" with ramp inputs



Solution :-

$$e(\infty) = \frac{1}{K_v} = \frac{a}{k} \quad \text{from} \quad K_v = \lim_{s\to 0} sG(s)$$

$$= \lim_{s\to 0} s \cdot \frac{K}{s(s+a)} = \frac{K}{a}$$

The sensitivity of e(∞) to changes in parameter "a" is

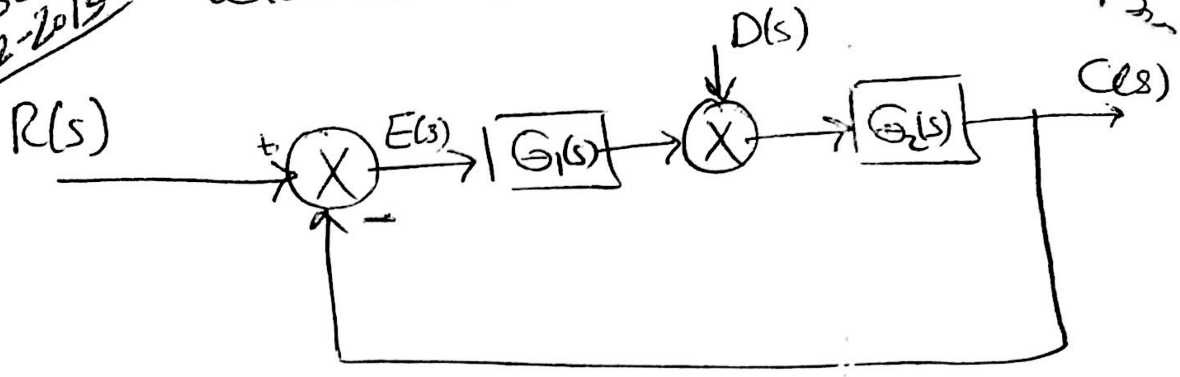
$$S_{ea} = \frac{a}{e}\frac{\partial e}{\partial a} = \frac{a}{\frac{a}{k}}\left[\frac{1}{K}\right] = 1$$

The sensitivity of e(∞) to changes in parameter "K" is

$$S_{ek} = \frac{k}{e}\frac{\partial e}{\partial k} = \frac{K}{\frac{a}{k}}\left[\frac{-a}{k^2}\right] = -1$$

E362
5-12-2013

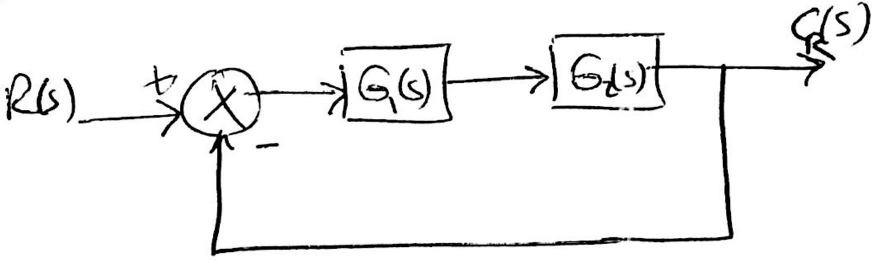
Steady State error due [illegible] [illegible] with disturbance



$$E(s) = R(s) - C(s)$$

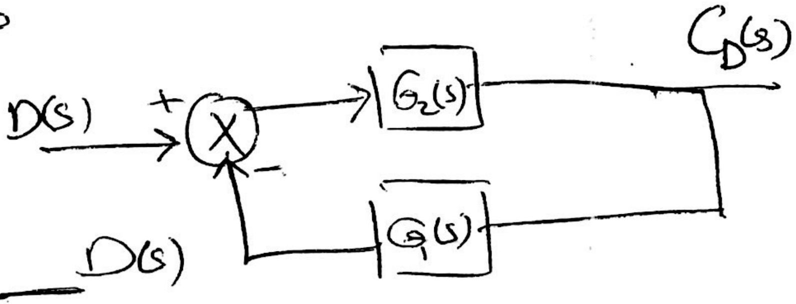
$$E(s) = R(s) - C(s)\Big|_{\substack{\text{due to } R(s)\\ D(s)=0}} - C(s)\Big|_{\substack{\text{due to } D(s)\\ R(s)=0}}$$

When $D(s) = 0$



$$C_R(s) = \frac{G_1(s)G_2(s)}{1 + G_1(s)G_2(s)} R(s)$$

When $R(s) = 0$



$$C_D(s) = \frac{G_2(s)}{1 + G_1(s)G_2(s)} D(s)$$

(s)

$$R(s) - C_R(s) - C_D(s)$$

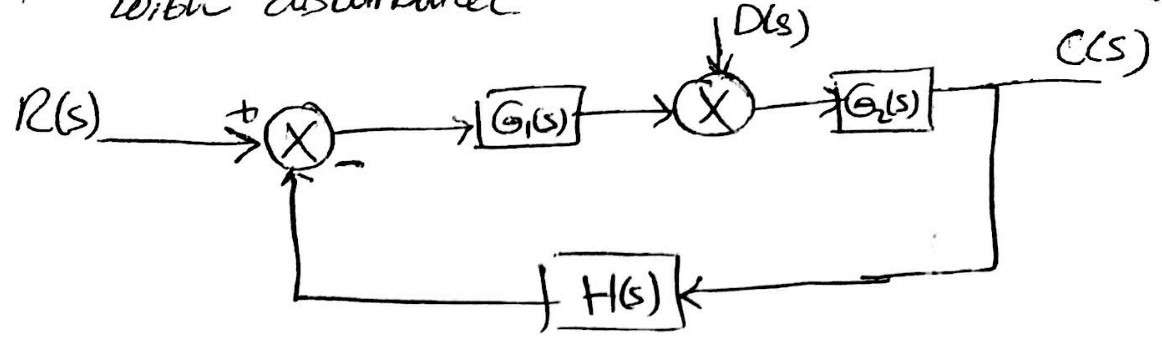
$$= R(s) - \frac{G_1(s)G_2(s)}{1+G_1(s)G_2(s)}R(s) - \frac{G_2(s)}{1+G_1(s)G_2(s)}D(s)$$

$$E(s) = \left[1 - \frac{G_1(s)G_2(s)}{1+G_1(s)G_2(s)}\right]R(s) - \left[\frac{G_2(s)}{1+G_1(s)G_2(s)}\right]D(s)$$

$$e(\infty) = \lim_{s \to 0} sE(s)$$

$$= \lim_{s \to 0} s\left\{\left(1 - \frac{G_1G_2}{1+G_1G_2}\right)R(s) - \left(\frac{G_2}{1+G_1G_2}\right)D(s)\right\}.$$

with disturbance



$$E(s) = R(s) - C(s)$$

$$E(s) = R(s) - C(s)\Big|_{\substack{\text{due to } R(s)\\ D(s)=0}} - C(s)\Big|_{\substack{\text{due to } D(s)\\ R(s)=0}} \longrightarrow \boxed{1}$$

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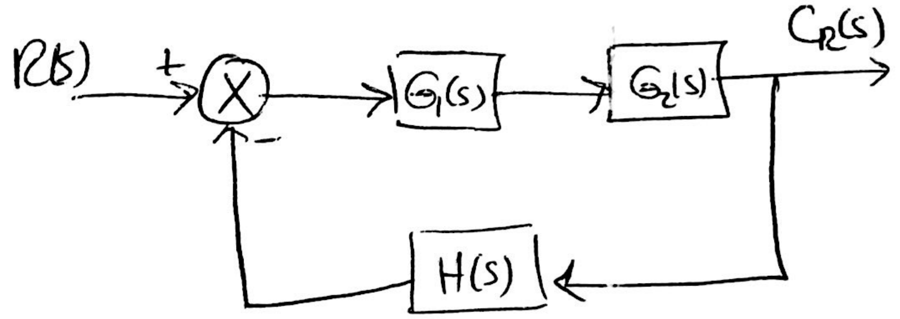
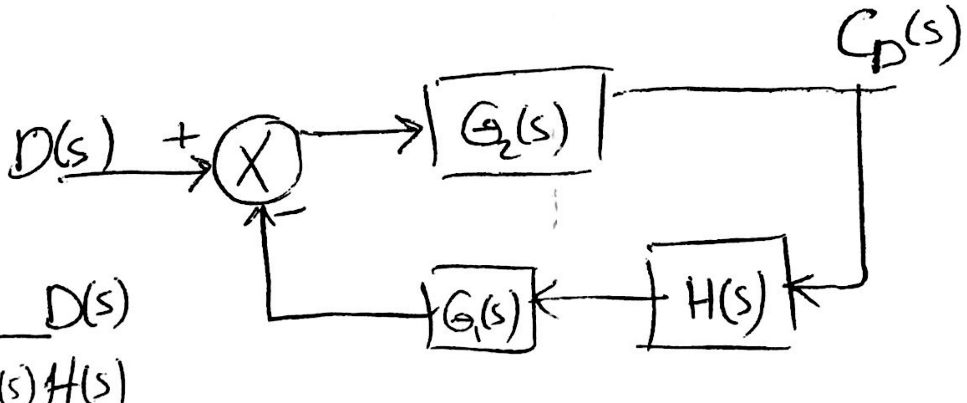
when $D(s) = 0$



$$C_R(s) = \frac{G_1(s)\,G_2(s)}{1 + G_1(s)\,G_2(s)H(s)}\,R(s)$$

when $R(s) = 0$



$$C_D(s) = \frac{G_2(s)}{1 + G_1(s)G_2(s)H(s)}\,D(s)$$

$\boxed{3}$

$$C(s) = C_R(s) + C_D(s) \qquad \boxed{4}$$

from $\boxed{1}$

$$E(s) = R(s) - C_R(s) - C_D(s)$$

$$E(s) = R(s) - \frac{G_1 G_2}{1+G_1G_2H} R(s) - \frac{G_2}{1+G_1G_2H} D(s)$$

$$E(s) = \left[1 - \frac{G_1G_2}{1+G_1G_2H}\right] R(s) - \frac{G_2}{1+G_1G_2H} D(s) \longrightarrow \boxed{2}$$

$$e(\infty) = \lim_{s\to 0} s\,E(s)$$

$$= \lim_{s\to 0} s \left\{ \left(1 - \frac{G_1G_2}{1+G_1G_2H}\right) R(s) - \left(\frac{G_2}{1+G_1G_2H}\right) D(s) \right\}$$

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